TOWARDS EFFICIENT APPLICATION OF SPEED-BUMPS AS TRAFFIC CALMING DEVICE IN SAKI WEST LOCAL GOVERNMENT AREA OF OYO STATE, NIGERIA.

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ABSTRACT

Driving in urban centers and neighbourhoods at high speed without regard to the safety of the inhabitants brought about the emergence of the use of speed bump and other calming devises. It is in view of this assertion that this study appraised the location and implementation impact of speed bumps in Nigerian urban centers, using Saki West Local Government Area of Oyo State as a reference point. The paper is anchored on the neurofuzzy concept to the design of road bumps and considered the effect of road bumps in the society as a whole. Using questionnaire as research instrument, 220 units of questionnaires were administered to randomly selected residents of the purposively selected areas in Saki West Local Government Area of Oyo State. Also, fifteen residential streets and four other major roads were purposively selected for this study. The paper established the indiscriminate mounting of speed bumps in the area by residents and community, irrespective of the functional classification of roads, and without recourse to statutory regulations and procedures. It also confirms that speed bumps in the study area are conical with irregular heights, width and length. Although the speed bumps improved safety in the areas, yet their perceived adverse effects on the passing vehicles, commuters and residents are enormous. In addition, the substandard and uncontrolled manners in which speed bumps are located and constructed in the study area have derogatory implications on their effectiveness as traffic calming toolbox. The correlation coefficient 'r' shows a very strong positive relationship (r = 0.85) between the height of speed bumps in the study area and rate of vehicular passage. While the paper is of the view that the design and construction of speed bumps should be a responsibility of the local government as practiced in developed nations, it also recommended the redesigning of the existing speed bumps with heights in excess of 21cm, subjection of the design and construction of future speed bumps to procedures and regulations, public enlightenment and sanctions on the arbitrary mounting of speed bumps in the area and other across the country as a whole.

Keywords: Speed Bump, Neurofuzzy, Traffic Calming, Safety and Saki West.

INTRODUCTION

Transport is life (Badejo, 2011) and has been contributory to the growth, development and prosperity of man and cities since time immemorial. Trekking, walking and human porterage were the dominant modes of transportation during the primitive, while the use of beast of burden and carts employed during the early civilization were replaced by automobiles (Okoko, 2006). Urbanization and industrialization together with continuous increase in automobiles have brought about increase in wealth and improved socio-economic undertakings, most especially for urban dwellers.

ISSN: 2277-0097

As cities becoming larger and numerous, there is overwhelming dominance of road sector (Badejo, 2014). The fact that Nigeria is becoming highly urbanized with unprecedented increase in vehicle ownerships is undisputed. As transport is a maker and most importantly, breaker of city (Ogunsanya, 2002), driving in urban centers and neighbourhoods at high speed without regard to the safety of the inhabitants become a common phenomenon. This situation characterize many state capitals, urban centers such as Ibadan, Lagos, Akure, Osogbo and medium sized settlements such as Ife, Ijebu-Ode, Owo and even Saki (Alabi, *et al* (2013).

The uncontrolled urbanization and absence of effective public transit system contribute immensely to the vulnerability of the urban dwellers to numerous risks associated with fast moving vehicles, especially within neighbourhoods. The inability of enforcing speed limits for fast-moving vehicles in urban centers and neighbourhoods had significantly increase the vulnerability of the pedestrians, cyclists, children, aged and physically-challenged within our neighbourhoods in particular and across various roads in the urban centers, Saki inclusive.

In addition to government efforts, various techniques were devised by the residents and communities across the globe to enhance their safety and discourage excessive speeding on urban roads and neighbourhood streets by fast moving vehicles. Among such efforts is the use of speed-bumps on neighbourhood roads. Since the development of speed bumps in the early 1970s by the Transport and road research laboratory of Great Britain (Parkhill *et al,* 2007), several countries in the developed and developing nations have embraced its application as traffic calming toolbox. With this, speed bumps play increasing role in the enforcement of speed limits (Oke *et al,* 2007b), and as a result, contribute to the enhancement of pedestrians' safety. Therefore, speed bumps aimed at breaking vehicular speeds in order to reduce the rate of road crash attributed to over-speeding, and to maintain speed limit in certain designated areas.

With the postulation that road traffic injuries will rank as third among the causes of disability-adjusted life years in 2020 (Lagarde, 2007) despite various frameworks in place, the use of speed bumps in minimizing road traffic injuries on Nigerians roads, especially in neighbourhoods and other settlements have to be examined. The perceived unregulated manners in which speed bumps are mounted on the roads within neighbourhoods and other urban settlements in the country also, call for urgent attention. For speed-bumps to be effective to curtail the escalating burden of road traffic injury in Nigerian urban centers, and Saki in particular, their mounting have to be carefully conceived, planned and logically constructed.

The dotting of various urban centers and other areas with speed bumps, especially in Saki; Saki West Local Government Area of Oyo State require thorough scrutiny to ascertain their effectiveness in enhancing safety of the residents, pedestrians and the vulnerable population in the society as a whole. It is in view of this assertion that this study appraised the location and implementation impact of speed bumps on Nigerian urban centers, using Saki West Local Government Area of Oyo State as a reference point.

SAKI WEST LOCAL GOVERNMENT AREA, NIGERIA

This study focused on Saki West Local Government Areas of Oyo State. Geographically, the study area is located between latitude 8^0 20′and 9^0 0′ North of the Equator and between longitudes $2^0$40′ and 3^0 50′ east and west of the Greenwich meridian respectively as well as of about 1,245m above the sea level. It is bounded in the North by Baruten Local Government in Kwara State, in the South by Atisbo, in the West by the Republic of Benin and in the east by Saki East Local Government Area.

ENTRENCHING THE CONCEPT OF NEUROFUZZY FOR SPEED BUMP DESIGN

The neurofuzzy concept to the design of road bumps considers the effect of road bumps on the vehicle system. The concept has been applied in the reinforcement learning of traffic signal control, for identification of autonomous underwater vehicles, in real time modeling and control as well as for robust parameter estimation and in vibration monitoring (Oke *et al,* 2007a). Therefore, there is a need to use and develop a practical approach such as the neurofuzzy approach which can deal with uncertainty in system parameters. It combines the inherent attributes of fuzzy logic and artificial neural networks. Fuzzy logic has the attribute of capturing uncertainty and imprecision.

The advantage of artificial neural networks in specifying more precisely the nature of uncertainty in a network is utilized. According to Oke *et al* (2009b), the starting point of the procedure for applying a neurofuzzy methodology is to define the input parameters that are used in the process towards obtaining the output. The basic input into the neurofuzzy model are mainly the bump height, the distance between two consecutives bumps, mass of the vehicle, width of the bump, the spring constant of the vehicle, the damping constant of the vehicle and the maximum speed that the vehicle could attain. The output that could be obtained from the modeling is basically three-fold: optimistic, pessimistic, and normal.

The optimistic output refers to a situation that is desired, the normal output relates to results that come out on the average, while the pessimistic output is the undesired level of output. The optimistic situation is the state where the maximum speed of the vehicle is lowest. This is the desired output that is of paramount concern in road bump design. This is a new contribution to the body of knowledge on road bump design. The approach improves on the use of fuzzy logic which attempts to capture imprecision and uncertainties.

REVIEW OF LITERATURES

Several scholars have expressed divergent views on the applications of speed bumps as traffic calming device. According to Alabi *et al* (2013), types of traffic calming measures include narrower traffic lanes, speed bumps, speed humps, speed tables, speed cushions and raised pedestrians crossing among many others; and are used where vehicle speeds are statutorily mandated to below with their height, ranges from 7.6 cm to 10 cm. In their contribution, Parkhill, Sooklall and Bahar (2007) described speed bump as a raised pavement area across a roadway in which the pavement surface extending transversely across the travel way. Oke *et al* (2007) with the believed that the main purpose of speed bumps is to break vehicular speeds in

order to reduce the rate of crash attributed to over-speeding as well as to maintain speed limits in designated areas.

Speed bump is observably, the most commonly used in residential streets of Saki town in Oyo State; and are of varying heights, lengths and materials even along the same street. While emphasizing the importance of speed bumps, Alabi *et al* (2013) note that although, speed bumps are effective in minimizing the vehicular speed, thereby preventing injuries and death, yet they are seemingly posing serious problems to motorists and residents presumably due to their poor designs, intervals and locations (Alabi, *et al,* 2013)

MATERIALS AND METHODS

Both primary and secondary data were employed for this study. 220 units of questionnaires were administered to randomly selected residents of the purposively selected areas in Saki West Local Government Area of Oyo State. Also, fifteen residential streets and four other major roads with speed bumps were purposively selected for this study. The questionnaire sought for information from the residents in the selected streets on the effectiveness of the mounted speed bumps in their areas as well as other related issued bordering on the procedure, planning, design and construction process of speed bumps in their vicinities.

In addition, personal and visual observation of the operations and the use of the speed bumps in the selected areas were undertaking. Measurement of the length, height and width of speed bumps were also undertaken in the study area. Information on the design, planning, construction and maintenance of speed bumps were sought from the department of Works of the Saki West Local Council and the State Ministry of Works and Transport office in Saki, Oyo state. The data obtained were later analysed descriptively using frequency tables, charts and plates, while correlational analysis was used to establish the relationship between the height of speed bump and rate of usage cum satisfaction among others.

RESULTS AND DISCUSSION

Materials and Providers of Existing Speed Bumps

The field survey conducted in the study area showed that all the speed bumps in the residential areas and roads were provided by the community (Table 1). However, many of the speed bumps (59.9 per cent) are made of concrete, while little over one quarter (29.8 per cent) were made of asphalt and the use of wooden material is less significant accounting for 3.5 per cent. However, slightly more than half (54.4 per cent) of the speed bumps are heaped, more than one-quarter (37.5 per cent) are conical, while hollow types accounted for 7.1 per cent of the sampled speed bumps in the area. Majority (80.7 per cent) of the speed-bumps is provided by the community, while individual, state, Federal and local government accounted for less significant proportion. The predominant use of concrete may not be unconnected with the fact that, it is easy for the community to get and use concrete than asphalt. Those speed bumps made of asphalt were reported to have been provided on the request of the community whenever roads are being constructed by the government within the Local Government Area.

The height and length of existing speed bumps were also investigated. Ideally, speed bump should have height ranging between 7.6 cm and 10 cm with the length of not less than 30cm. However, it is shown in Table 1 that slightly less than half (42.1per cent) of the existing speed bumps are between 16 cm and 20 cm in height, while little over one-quarter (28.1 per cent) have between 21 cm and 25 cm heights. More than one-tenth (17.5 per cent) of the speed bumps have heights of between 11cm and 15 cm, while less than one-tenth (8.8 per cent) are of 7.6cm to 10cm. It is also inferred from the analysis that, most of the existing speed bumps (87.7 per cent) are of height above the standard, while few (8.89 per cent) satisfied the height standard for such.

On the length of the existing speed bumps, almost three-quarter (73.7 per cent) have length of between 31cm and 60 cm, while a little over one-tenth (15.8 per cent) have less than 30 cm as their lengths. A small proportion of the sampled bumps (10.5 per cent) which a found in Apinite/Coca cola road have length of between 61 cm and 90 cm. By implication, most of the existing speed bumps (84.2 per cent) have length more than the standard. The non-compliance with the height and length requirements/standards for design and construction of speed bumps may be due to the fact that the communities were solely responsible for their design and construction without subjecting such to physical planning and engineering control by relevant government agencies. In addition, the survey revealed that more than a quarter (28.1 per cent) of the bumps are in good condition, while close to half (40.4 per cent) are partially deformed. The remaining 31.6 per cent of the sampled bumps in the streets are totally deformed.

Ground Clearance of Sampled Vehicles

The height of the vehicle frame/ base plate from the ground was also examined in the study area. Slightly more than half (51.4 per cent) of the sampled vehicles were of low ground clearance (i.e. less than 25cm), while about three-quarter (34.1 per cent) have medium ground clearance (26-30cm). In addition, slightly more than one-tenth (11.4 per cent) of the vehicles were of high ground clearance, while a small proportion (3.2 per cent) has a very high ground clearance. However, there is a nexus between the ground clearance of vehicle and the height of speed bumps mounted on the roads. Speed bumps with height of more than 15 cm present a difficulty for a vehicle especially with ground clearance of less than 25 cm (i.e. vehicles such as cars and suv) to pass over them at a very low speed. Uninterestingly, more than three-quarter (87.6 per cent) of the existing speed bumps have more than 10 cm as heights, while more than 51.4 per cent of the vehicles have less than 25 cm ground clearance.

Impacts of Existing Speed Bumps on Vehicle and Residents

The study also examined motorists' views on the existing speed bumps on both the vehicles. From Table 2, less than two-third of motorists (44.5 per cent) pointed at the general damage to vehicle as the effect of speed bumps, while 15.5 per cent fingered damage to the wheel as the effect. Further, over one-quarter (26.4 per cent) of residents agreed that speed bumps increased fuel consumption of vehicle as it move on a lower speed, while less than a quarter (21.4 per cent) identified suspension dislocation. More than one-tenth of motorists (12.3 per cent) identified

clutch-burning and the remaining one-tenth (10.0 per cent) expressed wheel misbalancing as the consequence of seed bumps experienced.

Also, less than a quarter of motorists (24.5 per cent) are discomforted by the mounting of speed bumps on the streets, while more than one-quarter (36.8 per cent) fingered chronic backache. Motorists who identified spinal pain accounted for less than one-tenth (16.8 per cent), while delay and frustration accounted of 11.8 per cent and 10 per cent of the responses received respectively. On the impacts of speed bumps on the residents and their vicinity, more than a quarter (36.8 per cent) identified improved human safety, while less than a quarter (21.4 per cent) fingered increase in pollution as vehicles move in lower gear and speeds. In addition, slightly higher than a quarter (26.8 per cent) saw the effect of speed bumps on residents to be noise, while 8.6 per cent expressed intense vehicle vibration. The remaining 6.4 per cent are indifferent in their response as traffic is usually diverted to parallel roads or streets.

With respect to the satisfaction of drivers and commuters to the speed bumps, more than half (53.2 per cent) are not satisfied with speed bumps, less than a quarter (19.5 per cent) expressed low satisfaction, while less than one-third (14.5 per cent) are moderately satisfied. The remaining 12.7 per cent account for those who are highly satisfied the provision of speed bumps in the study area. However, the correlation coefficient 'r' shows a very strong positive relationship (r = 0.85) between the height of speed bumps in the study area and rate of vehicular passage in the streets/roads. Thus, the study is of the view that heights of the speed bump have significant impact and influence on the degree of satisfaction of the users as well as the rate of passing through such street/road by motorists among other factors.

CONCLUSION AND RECOMMENDATIONS

This study appraised the use of speed bumps as traffic calming device in Saki West Local Government Area of Oyo State with the intention of enhancing safety of residents and the vulnerable in the vicinities. The paper established the indiscriminate mounting of speed bumps in the area by residents and community, irrespective of the functional classification of roads, and without recourse to statutory regulations and procedures. It also confirms that speed bumps in the study area are conical shape with irregular height, width and length. Although the speed bumps minimize accidents and injury in the areas, yet their perceived adverse effects on the passing vehicles and commuters are enormous. In addition, the substandard and uncontrolled manners in which speed bumps are constructed as well as their high rate of deformation derogatory implications on their efficiency and effectiveness as traffic calming toolbox in the study area.

In order to reduce the consequences of speed bumps on the vehicles and residents in the study area as well as to enhance their positive impacts, the following recommendations are suggested:

i. The existing speed bumps with height of more than 21cm that are mostly found in Okere-Isale Adinni road, Sango-Iya-Igboro road and Owonsoloko Street should be re-designed and re-constructed.

ii. The design and construction of speed bumps on any road should be subjected to control and regulation of appropriate department of the government for improved operational efficiency and safety. Such departments should ensure optimum compliance of speed bumps to stipulated height, length, widths, materials and locations.

iii. The Local Government Council should embark on enlightenment campaign on the arbitrary mounting and construction of speed bumps by community members in their vicinity without recourse to stipulated procedures and regulations.

iv. The design and construction of speed bumps is a local government affair as being done in developed world. Thus, individual and communities should request for such to their Local Government Authority. In replicating such in the study area and the country at large, the principles of public involvement and community participation should be integrated into the design and construction of speed bumps in the future.

v. The arbitrary construction of speed bumps on roads, especially where speed is not meant to be low in expressways such as Koomi/Ajegunle road and Poly/Sango road should be stopped immediately, and such should be dismantled accordingly. Adequate sanctions should be accorded to individuals or community leaders and members who embark on construction of speed bumps without government approval.

REFERENCES

Alabi, F. M., Ajadi, K.O., Akanmu, A. A. and Ogunsesan, D. K. (2013). 'The Use of Speed-Humps as Traffic Calming Device in Residential Neighbourhood Streets of Saki Town: Design and Effects', Paper Presented at the Campus Conference Series of Saki Campus, The Polytechnic, Ibadan, Nigeria between 28th and 29th January, 2013.

Badejo, B. A. (2009). Transportation: Removing the Clogs to Nigeria's Development, Anchorage Press and Publishers. Lagos.

Badejo, B. A. (2014). Transporting the Future Today: Portrait of Nigeria, 65th Inaugural Lecture, Olabisi Onabanjo University Ago-Iwoye, Nigeria, February 11, 2014.

Lagarde, E. (2007). Road Traffic Injury is an Escalating Burden in Africa and Deserves Proportionate Research efforts, PLOS Medicare, vol. 4, no. 6, July Edition, pp1-5.

Ogunsanya, A.A. (2002). Maker and Breaker of City, 59th Inaugural Lecture, University of Ilorin, Nigeria, 22nd June 2002.

Oke, S. A. et al (2007a). Application of Neurofuzzy in the Development of Road Bump Designs, *The Pacific Journal of Science and Technology*, Vol. 8, No. 1, pp 73-79.

Oke, S. A. et al (2007b). Mathematical Modelling of the Road Bumps Using Laplace Transform, *International Journal of Science and Technology,* Vol. 2, No. 2, pp 129-141.

Okoko, E. (2006). Urban Transportation Planning and Modelling, Millennium Publishers, Akure.

APPENDIX

Table 1: Design and Physical Attributes of the Speed Bumps in the Study Area

Variable Used		Frequency	Percentage
Types of bumps:	Conical	21	38.8
	Heaped	32	56.2
	Hollow	4	7.0
Material Used:	Concrete	33	57.9
	Asphalt	17	29.8
	Wood	2	3.5
	Earth surface	5	8.8
Providers:	Individual	5	8.8
	Community	46	80.7
	Government	6	10.7
Heights:	< 7.6cm	2	3.5
	7.6-10 cm	5	8.8
	11-15cm	10	17.5
	16-20cm	24	42.1
	21-25cm	16	28.1
Length:	< 30cm	8	15.8
	31.60cm	42	73.7
	61-90cm	6	10.5
Existing Condition:	Good	16	28.1
	Partially deformed	23	40.4
	Totally deformed	18	31.6
NB: Total sample was 57.			

Source: Authors' Field Survey, September 2012 and February 2014.

Table 2: Motorists/Commuters' Perception of Speed Bumps in the Study Area

Variable Used		Frequency	Percentage
Vehicle ground clearance:	Low clearance (<25cm)	113	51.4
	Medium clearance (26-30cm)	75	34.1
	High clearance (31-35cm)	25	11.4
	Very high clearance (>35cm)	7	3.2
Effects on vehicle:	Damage to vehicle	32	14.5
	Increased fuel consumption	58	26.4
	Wheel damage	34	15.5
	Suspension dislocation	47	21.4
	Clutch burning	27	12.3
	Wheel misbalancing	22	10.0
Effects on drivers:	Discomfort	54	24.5
	Chronic backache	81	36.8
	Spinal pain	37	16.8
	Delay	26	11.8
	Frustration	22	10.0
Effects on commuters:	Discomfort	88	31.4
	Chronic backache	52	23.6
	Spinal pain	30	13.6
	Delay	41	18.6
	Frustration/stress	28	12.7
Effects on residents:	Pollution	47	21.4
	Noise	59	26.8
	Safety improvement	81	36.8
	Vibration	19	8.6
	Indifference	14	6.4
Satisfaction with speed bumps:	Not satisfied	117	53.2
	Low satisfaction	43	19.5
	Moderate satisfied	32	14.5
	Very satisfied	28	12.7
NB: Total sample was 220.			

Source: Authors' Field survey, September 2012 and February 2014.

Reference to this paper should be made as follows: Akanmu, A. A. et al. (2014), Towards Efficient Application of Speed-Bumps as Traffic Calming Device in Saki West Local Government Area of Oyo State, Nigeria. *J. of Environmental Sciences and Resource Management,* Vol. 6, No. 2, Pp. 127 – 136.